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HOW TO FLY

CAPTAIN D. GORDON E. REVLEY



Given in memory of
JOHN BEVERLY PRESTON
by Mrs. A. T. Mercier

JOHNNY PRESTON, Class of 1930, was a man in whom the spirit of competition burned deeply. As a varsity football player whose crashing end play belied his 170 pounds, he earned Coach Glenn Warner's praise as "one of the greatest ends I've ever coached."

This same venturesome spirit impelled him to turn to aviation as his life's work. Upon his graduation from Stanford, he went to Kelly Field, Texas, where he won his second lieutenant's commission in 1931. For the next five years he served as an officer in the Air Force.

In 1936, while on flying duty at Fort Lewis, Washington, he suffered a spinal injury which ultimately terminated his military career. Despite his injury, he trained Chinese cadet pilots under General Claire Chennault in 1940-41. Denied the right to fly in World War II, he served as an aircraft inspector, and later as a private flying instructor.

Paramount in his life, which ended tragically on October 11, 1949, was his devotion to three causes: his University, his country, and aviation. This, one of a collection of books established in his memory, is a tribute to that devotion.

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the 1990s, the number of people in the UK who are obese has increased by 50% (Health Survey for England 2001). The prevalence of obesity in the UK is now 10% in men and 13% in women (Health Survey for England 2001). The prevalence of obesity in the USA is 15% in men and 23% in women (Flegal et al. 2002). The prevalence of obesity in the USA is higher than in the UK, but the prevalence of obesity in the UK is increasing rapidly.

Obesity is a major risk factor for a number of chronic diseases, including coronary heart disease, stroke, type 2 diabetes, and certain types of cancer (World Health Organization 2000). Obesity is also a risk factor for a number of other health problems, including arthritis, asthma, and depression (World Health Organization 2000).

Obesity is a complex condition, and its causes are not fully understood. It is thought to be caused by a combination of factors, including genetics, environment, and lifestyle (World Health Organization 2000). Obesity is a preventable condition, and it is important to take steps to prevent it.

Obesity is a preventable condition, and it is important to take steps to prevent it. This includes eating a healthy diet, getting regular exercise, and avoiding tobacco and alcohol (World Health Organization 2000).

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HOW TO FLY



D. E. Riley

HOW TO FLY

(The Flyer's Manual)

A PRACTICAL COURSE OF
TRAINING IN AVIATION

BY

CAPTAIN D. GORDON E. RE VLEY

ARRANGED BY GLAD LEWIS



NINETEEN SEVENTEEN
PAUL ELDER AND COMPANY
SAN FRANCISCO

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: : :

**ENTERED AT
STATIONERS' HALL
LONDON**

**TO THOSE WHO GO UP
IN THE AIR IN PLANES**



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Captain D. Gordon E. Re Vley

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PREFACE

With a desire to train an aviator into proper capability so that he may, when embarking on his career, have skillful and complete knowledge of his profession, and fly without those disastrous and unnerving consequences attendant on the average flyer's entrance into this science, brought about through inadequate and incomplete training in many of the present Aviation Schools, this manual is set forth.

Captain D. Gordon E. Re Vley, Licensed Pilot Number 191, Fédération Aéronautique Internationale, who advocates this theory of proper training, learned the frailties and faults of the Dual Control System of instruction on the fields in Europe, observing that the stu-

PREFACE

dent and instructor seated in one machine bred a tendency to lack of self-control and confidence in the former when he was at last graduated and permitted to fly alone. Robbed of his dependency—thrown all at once entirely upon his own resources in the sky—the question was naturally bound to arise in his breast: "Am I capable?" and in this instant a doubt entered that seriously handicapped his future work.

By leading up to the sky-work in a series of graduated flights on the field and over the field, after the theory of flying is properly instilled, the student has never the opportunity to doubt his own self-reliance since he is dependent on himself from the start. Step by step he comes into a knowledge of atmospheric conditions, and grad-

PREFACE

ually the control of the plane becomes instinctive—he becomes part and parcel of that plane, self-reliant and efficient to counteract whatever eventuality may crop out in his flights.

We believe a system as logical, brief and understandable as this here set down cannot fail to win the approval of schools throughout the country and the world. We hope, for the future of aviation, that a standardized and simplified and complete course, worthy of so broad a science, will be in general usage.

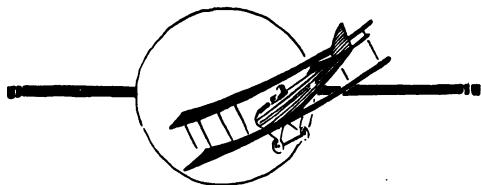
HOW TO FLY is the result of years of training, observation, instruction and experience on the part of one of America's pioneer aviators, whose work at home and abroad has won him a foremost place in the ranks of bird-men.

PREFACE

His theory: "Do not rush students through their training—give them from six to nine months of instruction. Haste makes waste, and the results cannot fail to justify the means" should be inscribed on the door of every hangar.

Summing up, we aim for clarity in the place of technicality, for what is comprehensive as well as compact and concise in this practical course of training in aviation.

GLAD LEWIS.



THEORY

THEORY

WHY AN AEROPLANE FLIES:

The speed necessary to raise an aeroplane from the ground is called its *Flying Velocity*.

In order to obtain its flying velocity in the air the plane must first obtain its flying velocity on the ground.

The aviator then pulls his control toward him, which gives his elevating planes a negative angle, thereby lowering the tail and simultaneously increasing the angle of resistance offered by his main supporting surfaces.

The flying velocity plus this added resistance forces the machine into the air.

*Nine-tenths
confidence
plus
one-tenth
common-
sense
equals
successful
aviator*

JOHN B.
MOISANT

*An
aeroplane
is as
safe
as
its
pilot* **TYPES OF MACHINES:**
There are three types of flying-
machines, the
ORNITHOPTER, or flapping-wing
(bird) type, unsuccessfully dem-
onstrated thus far, the
**ORVILLE
WRIGHT**

HELICOPTER, a series of propellers minus supporting surfaces in the form of planes, a type also unsuccessfully demonstrated thus far, and the

AEROPLANE, sub-divided into three classes or types, the

MONOPLANE, a single sustaining surface after the manner of a bird with rigid wings, the

BIPLANE, two surfaces, one above the other, the

TRI- and MULTIPLANES, three or more surfaces, one above the other.

THEORY

There is one other sub-division which applies as well to any or all of these types of aeroplanes, the

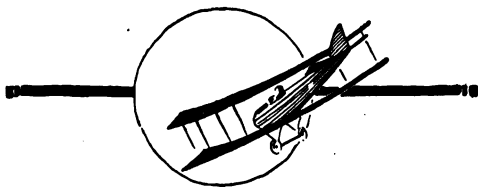
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TRACTOR TYPE, having the propelling power in the front, pulling; the

PUSHER TYPE, having the propelling power in the back, pushing.

JOHN B.
MOISANT

The SEA-PLANE or HYDRO-AERO-PLANE may be any one of the above types of aeroplanes with the addition of pontoons for rising from and landing on water.



CONTROL

CONTROL

Due to the fact that the

DEPERDUSSIN CONTROL, more widely known as the "DEP," has been adopted by the United States Government, and specified for all Army and Navy Flying-Machines, the course of instruction here set forth has been arranged for this control system.

Instructors of flying who wish to apply this course to any system other than the "Dep," may do so very readily.

The student, after thoroughly familiarizing himself with the aviation terms and the construction of his plane, should commence his course of instruction in practical flying with daily two-hour sessions in the hangar.

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An aeroplane is as safe as its pilot He should seat himself in the machine, concentrating deliberately on his controls.

ORVILLE WRIGHT *Pushing the Wheel Away From Him*, the elevating planes are lowered, increasing their angle of resistance and raising the tail; an action applied first in starting to clear the tail-skid from the ground, at all other times in descending. In direct countervail, by

Pulling the Wheel Towards Him, the elevating planes are raised, increasing their angle of resistance in the opposite direction, thereby lowering the tail and causing the machine to rise.

Steering is done to the right and left by the action of a vertical rudder attached to a foot-bar, controlled by both feet.

CONTROL

To Effect the Right-hand Turn it is necessary to push forward with the right foot;

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To Effect the Left-hand Turn it is necessary to push forward with the left foot.

In Flying, either in making the right-hand or left-hand turn, or due to the action of a sudden puff of wind, the machine may tilt side-ways. This tilt is counteracted through the WARPING SYSTEM or by the AILERONS.

JOHN B.
MOISANT

To control the ailerons the wheel is turned away from the lower side, toward the higher side.

This action simultaneously lowers the aileron on the lower side and raises the aileron on the higher side, thereby increasing the angle of resistance of the aileron on the lower side causing

HOW TO FLY

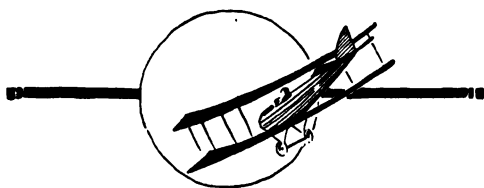
An that side to come up, and increasing the angle of resistance of the
aeroplane
is as
safe
as
its
pilot opposite direction causing that side to come down, leveling the plane.

ORVILLE
WRIGHT

In Making a Turn in the air, beside the action of the foot-bar, it is necessary to counteract the bank by warping against the turn, and it is advisable to point the machine downward by pushing forward the wheel.

These three actions made at one time require the efficiency of instinct in the matter of control, obtained *only* by careful concentration in the hangar; and this is characteristic of every combination of control units.

All Movements Must be Made Slowly!



GRASS-CUTTING OR ROLLING

GRASS-CUTTING OR ROLLING

As a precautionary measure before starting into the air it is essential that the student make it a *habit* to inspect his machine: the radiator, to ascertain the quantity of water contained therein; the tanks for the proper amount of gasoline.

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MOISANT

It is well to remember that La Blanc lost the Gordon-Bennett Cup Race at Belmont Park, Long Island, solely because of neglect on the part of his mechanician to fill the tanks of his machine to capacity. La Blanc, himself, neglected to oversee this vital part of his equipment and ran out of fuel on the last stretch of his journey.

The student must learn to mount his machine systematically: that

HOW TO FLY

An is to say, with the least amount of
aeroplane clambering.

is as
safe Immediately on entering the
as cockpit, let him see to it that the
its
pilot *Motor Is Short-circuited.*

ORVILLE
WRIGHT The motor started, he is under
way.

Taking for granted that the propeller is turning clockwise from the cockpit, the first movement is to shove the rudder to the right in order to counteract the

TORQUE, a moment of twisting-force due to the reaction of the propeller turning in the opposite direction. This force will always, at the start of a single-propellered machine, deviate the machine from its true course in an opposite direction to the swing of the propeller.

Simultaneously with the coun-

GRASS-CUTTING OR ROLLING

teraction of the torque, the wheel should be pushed forward in order to lift the tail clear of the ground.

With Sufficient Practice the student can master the art of balancing his machine on a perfect level while he is rolling on the ground and running in a straight line.

Concentration on this part of the work is highly important. The most skillful of pilots are those who have spent the greater portion of their student days learning to "cut grass." Success on the ground means ultimately success in the air.

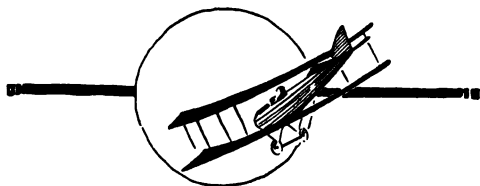
There are students who master this phase of flying very readily; others have found it difficult.

It must be "kept at," and, so, eventually conquered.

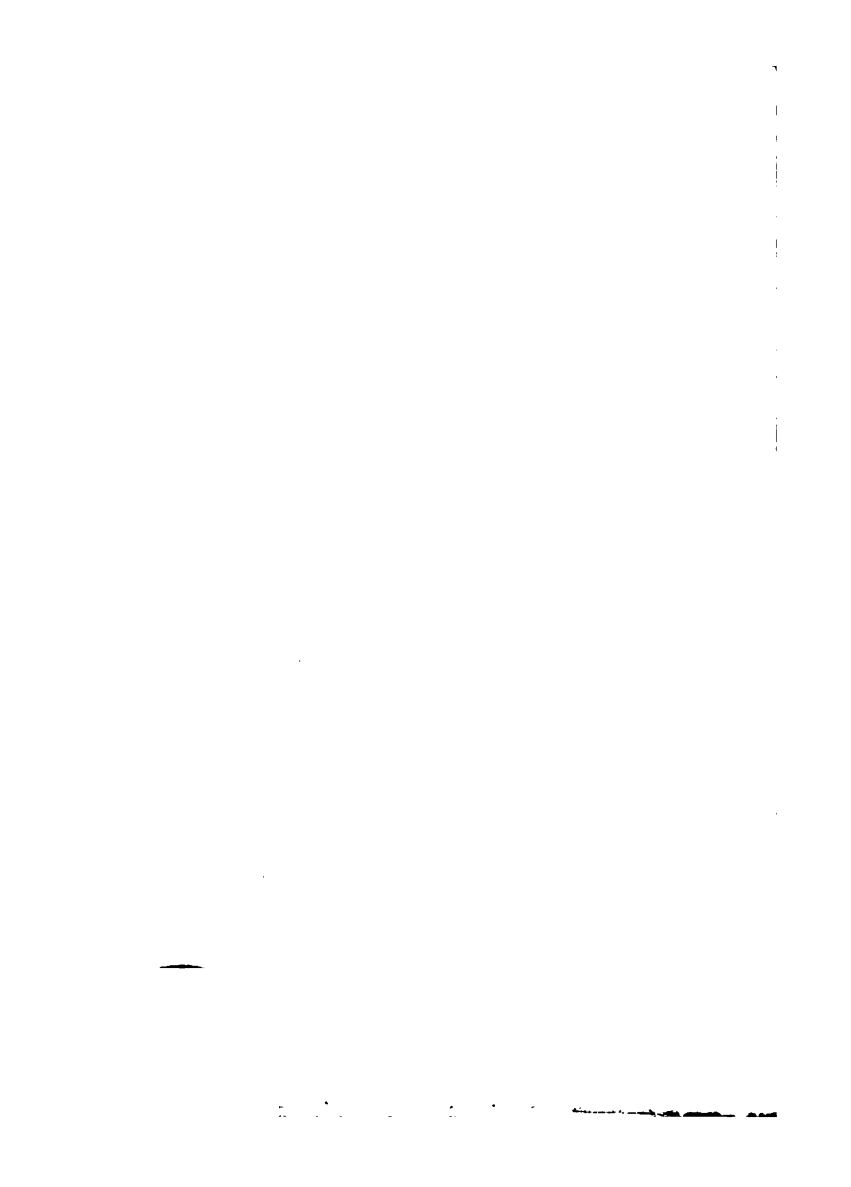
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HOPPING



HOPPING

After the student has thoroughly mastered the art of TAXI-ING (or Grass-Cutting), he may learn the sensation of leaving the ground.

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The Hopping Stage means merely getting off the ground a height of several decimeters and immediately returning to earth, there being as many as twenty or thirty hops in one stretch of the aviation field.

JOHN B.
MOISANT

To practice hopping, the student, after his accustomed regular inspection of his machine, which is at all times the initial action, gets under way as if he were going to "cut grass."

After the torque is counteracted and the tail leveled, and the machine seems to be skimming the

HOW TO FLY

An surface of the earth, the wheel is
aeroplane pulled *slowly* towards him, which
is as causes the machine to leave the
safe ground.
as
its

pilot Almost at once he must level out
the plane by pushing the wheel
ORVILLE *slowly* forward, never permitting
WRIGHT the machine to rise more than two
decimeters from the ground.

Flying now at an altitude of six
or seven inches, by pushing the
wheel forward *slowly* a fraction,
thereby returning to earth, the
student will have essayed his first
landing.

It is essential to practice these
short hops until capable of flying
the entire stretch at an altitude
below one meter.

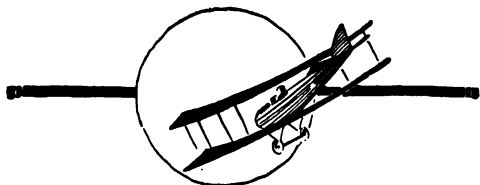
This action is still a part of the
student's ground-work. It is ad-
visable to spend the greater por-

HOPPING

tion of the time devoted to ground-work on this particular phase. It goes without saying that the flyer who trains himself to handle an aeroplane skillfully within one meter of the ground will be equally efficient at one thousand meters. This is a most delicate and trying business. The student should elevate his plane by fractions always—not in a jerky or spasmodic manner.

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MOISANT



STRAIGHTAWAY

STRAIGHTAWAY

After the student has thoroughly mastered the art of hopping he may learn the

STRAIGHTAWAY in three successive stages.

In its first stage the straightaway is the action of leaving the ground for an altitude of not over one meter and essaying a landing as soon as that altitude is reached, *i. e.*, a long hop.

In its second stage the student rises to an altitude of not over one meter and flies the entire length of the aviation field before essaying a landing.

In its final stage the student rises to an altitude of between ten and seventeen meters and flies the

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HOW TO FLY

*An entire length of the aviation field
aeroplane is as before essaying a landing.*

*safe To make a successful straight-
as away the student must have by
its this time mastered his LATERAL
pilot CONTROL, or WARP.*

ORVILLE
WRIGHT

To Practice the Straightaway, the student, after his accustomed regular inspection of his machine, gets under way as if he were going to make a hop. As he feels the machine leave the ground, he allows it to rise a moment longer than in making a hop, and then levels out. He is now flying at an altitude of not more than one meter. By pushing the wheels *slowly* forward, he descends at a very slight angle.

Only two or three hops are now necessary to cover the entire length of the aviation field.

STRAIGHTAWAY

In Graduating Into the Second Stage of the Straightaway, the student rises again to an altitude of not more than one meter, levels out at that height, and does his utmost to keep the machine at this exact altitude the entire length of the field.

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This is an extremely difficult feat owing to the fact that the student is now really flying—the machine is entirely at his mercy. He not only has his elevator- and rudder-controls to operate, but at this stage brings the warp, or ailerons, into play. Frequently a side wind or a sudden puff will cause the machine to tilt sideways either right or left. This tilt must be immediately counteracted by *slowly* warping against the slant.

After fully mastering the

HOW TO FLY

An aeroplane is as safe as its pilot straightaway at an altitude of one meter — being competent to actually fly the length of the field—the student is ready to enter into the

Final Stages of Straightaway Flying, by gradually mounting to higher altitudes—by flying the length of the field successively at a two-meter elevation, three-meter, five-meter, seven-meter, and so on up to seventeen meters, according to the length of flights the area of the aviation field will permit.

It must be borne in mind that mounting an aeroplane to almost any height is a simple enough matter; the difficulty arises in a return to earth with a properly executed landing. It is therefore essential to reserve sufficient room to descend at a very slight angle, which brings us to an analysis of

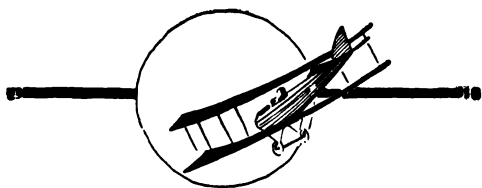
STRAIGHTAWAY

LANDINGS:

Taking it for granted that the student is flying at an altitude of eight meters and wishes to land, he pushes the wheel *slowly* forward at a very slight angle. When an altitude of approximately two meters is reached, he levels out, then cuts the engine off, and keeps the machine at this slight elevation until it glides with its own velocity to the ground.

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**LEFT-HAND TURN AND
RIGHT-HAND TURN**

LEFT-HAND TURN AND RIGHT-HAND TURN

After the student has thoroughly mastered the straightaway, he is then ready to learn the

LEFT-HAND TURN, by mounting to an altitude of eight meters, leveling out his machine, rising again another eight meters and leveling out his machine, and so on in steps until he has negotiated a height of approximately fifty meters. Leveling out at this altitude for a small distance, or as great a distance as the field will permit, the student is ready to essay his first turn.

He pushes the left foot *slowly*, warps to the right, pushing the wheel forward at the same time. The result will be a wide turn to the left with a very slight bank

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HOW TO FLY

An and a descent of some three to five
aeroplane meters.

is as

safe

as

its

pilot

ORVILLE

WRIGHT

The machine is straightened out for a second straightaway by pushing the rudder back to neutral, bringing the warp back to neutral, and leveling out. At this point it is well to ascend the altitude lost in making the turn, thus re-attaining the proximate fifty meters.

Continued flight at this height down the width of the field allows of a similar turn at the next corner, and a return down the length of the field. The fourth and last turn is made with a view to landing. The student gradually descends, and at an altitude of two meters cuts his engine off and allows the machine to glide with its own velocity to the ground.

It is advisable to repeat the left-

LEFT- AND RIGHT-HAND TURNS

hand turn around the area ten or fifteen times. The student may make two or three complete circles of the field before landing, if he feels competent and so inclined.

In making the

RIGHT-HAND TURN, the student repeats the exact processes observed in the left-hand turn *in the Opposite Direction, i.e.*, he pushes the right foot *slowly*, warps to the left, pushing the wheel forward at the same time. The result will be a wide turn to the right with a very slight bank and a descent of some three to five meters.

The machine is straightened out for further straightaway flight exactly as in the left-hand turn.

Note: An observant student will perceive that in the left-hand turn the machine will attempt to *De-*

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HOW TO FLY

An aeroplane is as safe as its pilot *ascend* of its own accord, while in the right-hand turn it will attempt to *Ascend* of its own accord. This is due to the propeller torque.

**ORVILLE
WRIGHT** *Caution:* While the pupil is actually flying it is well not to be over-confident, as over-confidence is as detrimental as lack of confidence.

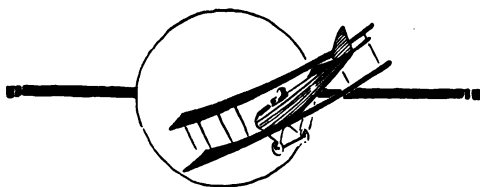


FIGURE EIGHT

FIGURE EIGHT

After the student has thoroughly mastered the left- and right-hand turns, he is then ready to make the left- and right-hand turns one after the other, thus essaying the

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FIGURE EIGHT, by leaving the ground headed for the left-hand corner of the aviation field. An altitude of fifty meters attained in successive steps (as set forth under preceding chapter), the student makes the right-hand turn at the foot of the field, and returns diagonally in a straight line, thereby crossing his former pathway in the center of the field.

At the head of the field he makes the left-hand turn, again crossing his former pathway above the center of the field, thereby complet-

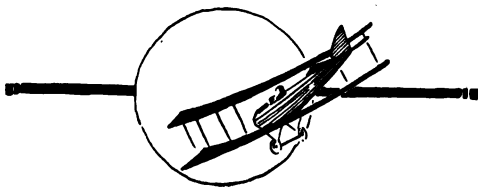
HOW TO FLY

An ing the figure eight and essaying a
aeroplane landing.

is as
safe It is advisable for the student to
as make wide, flat circles in accom-
its plishing the turns; not yet to at-
pilot tempt to bank too steeply.

ORVILLE
WRIGHT

Ten figure eights will suffice to master it. The student may make two or three before landing if he feels competent and so inclined.



**VOLPIQUEING AND
VOLPLANING**

VOLPIQUEING AND VOLPLANING

After the student has mastered the art of landing successfully with the motor on, he is ready to learn to

VOLPIQUE, by landing with the motor successively on and off.

Essaying a landing from a given height, the student points the nose of his machine gently downward at a slight angle. He cuts the engine off, glides for a few moments, turns the engine on again for a few moments still descending at the same angle, cuts the engine off again, and on again, and so on to within a distance of two meters from the ground, when, having leveled out, he cuts the engine off for the last time and allows the ma-

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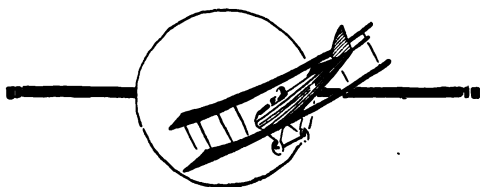
HOW TO FLY

An chine to glide with its own veloc-
aeroplane ity to the ground.
is as

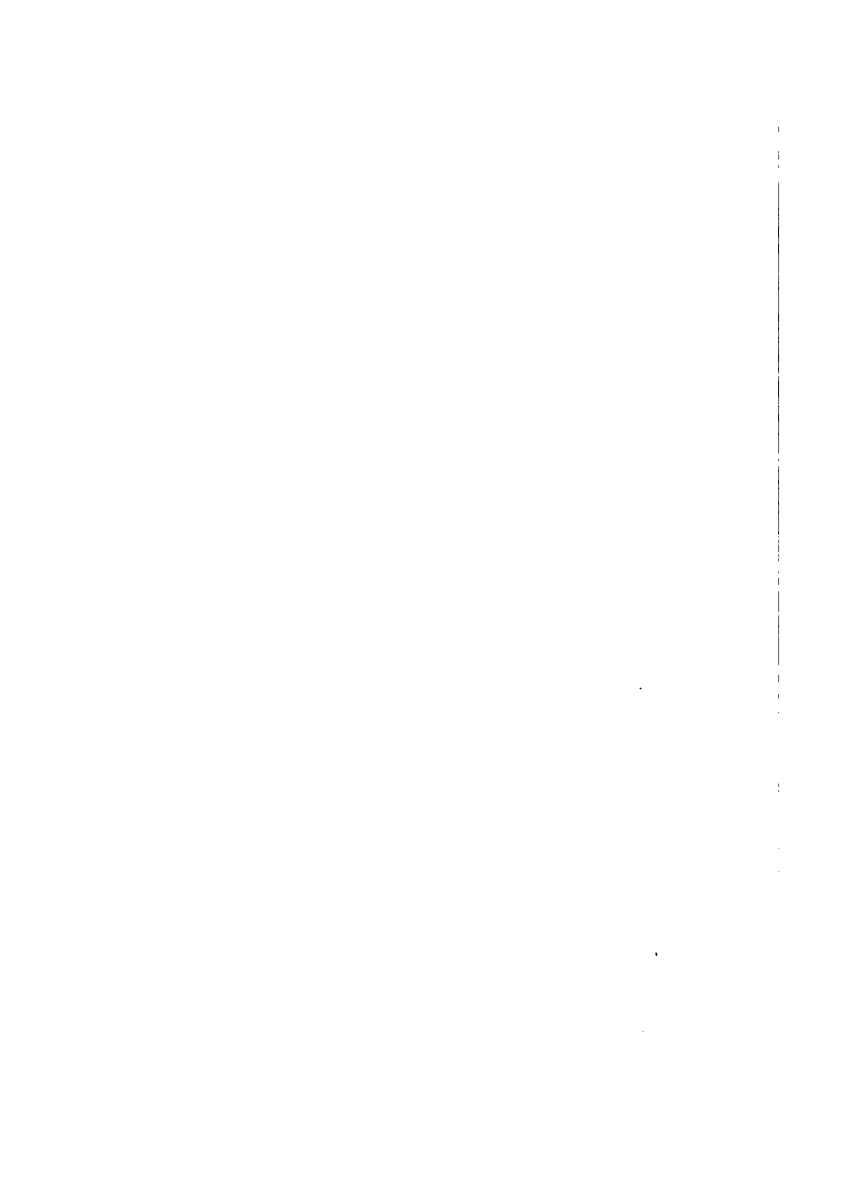
safe To VOLPLANE is to glide.

as To essay a landing by volplan-
its ing, the student cuts his engine off
pilot at a given height, noses his ma-
ORVILLE chine downward gently, but at an
WRIGHT angle great enough to assure him
a flying velocity, and lands with-
out again applying his power.

Note: It is important for the student to spend as much time as possible in the practice of landings.



PILOT'S LICENSE



PILOT'S LICENSE

At this stage of his aviation career, the student is ready to fly for his

PILOT'S CERTIFICATE, the demand for which is as follows:

Ten Figure Eights at an altitude of fifty meters, with additional specifications and limitations.

Officials of the AERO CLUB OF AMERICA lay out a rectangular course on the aviation field. A pylon is placed on each end of the given course, designating the turns.

The student now takes the air, rising to an altitude of fifty meters, and cuts five distinct figure eights, crossing between the pylons and making his turns outside of them.

Nine-tenths confidence plus one-tenth common-sense equals successful aviator

JOHN B.
MOISANT

HOW TO FLY

*An
aeroplane
is as
safe
as
its
pilot* In landing he must cut his engine off five meters from the ground in order to glide to earth and stop the machine's roll within fifty meters of the given landing-point.

ORVILLE
WRIGHT

This process, or flight, must be repeated.

Note: If the student has cut his figure eights below an altitude of fifty meters, it is required that he make an additional flight rising to fifty meters elevation.

Having accomplished his Certificate or License, the pilot will now be capable of passing, if he so desires, the

PRELIMINARY FLYING TEST as prescribed by the United States Government, as follows:

PILOT'S LICENSE

1. Three sets of figure eights around pylons 1,600 feet apart. In making turns around pylons all parts of machine will be kept within a circle whose radius is 800 feet.

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equals
successful
aviator*

2. Stop motor at a minimum height of 300 feet, and land, causing machine to come to rest within 150 feet of a previously designated point.

JOHN B.
MOISANT

3. An altitude test consisting of rising to a minimum height of 1,000 feet.

4. Glides with motor throttled, changing direction 90 degrees to right and left.

Note: 1 and 2 may be executed in one flight; 3 and 4 in one flight. The same rules apply in starting from and landing on water. Spe-

An cial attention will be paid to the
aeroplane character of landings made.
is as

safe

as

its

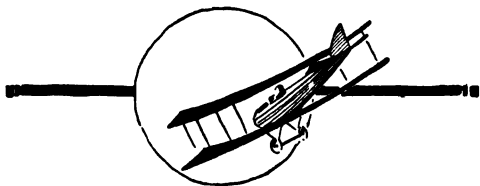
pilot

ORVILLE
WRIGHT

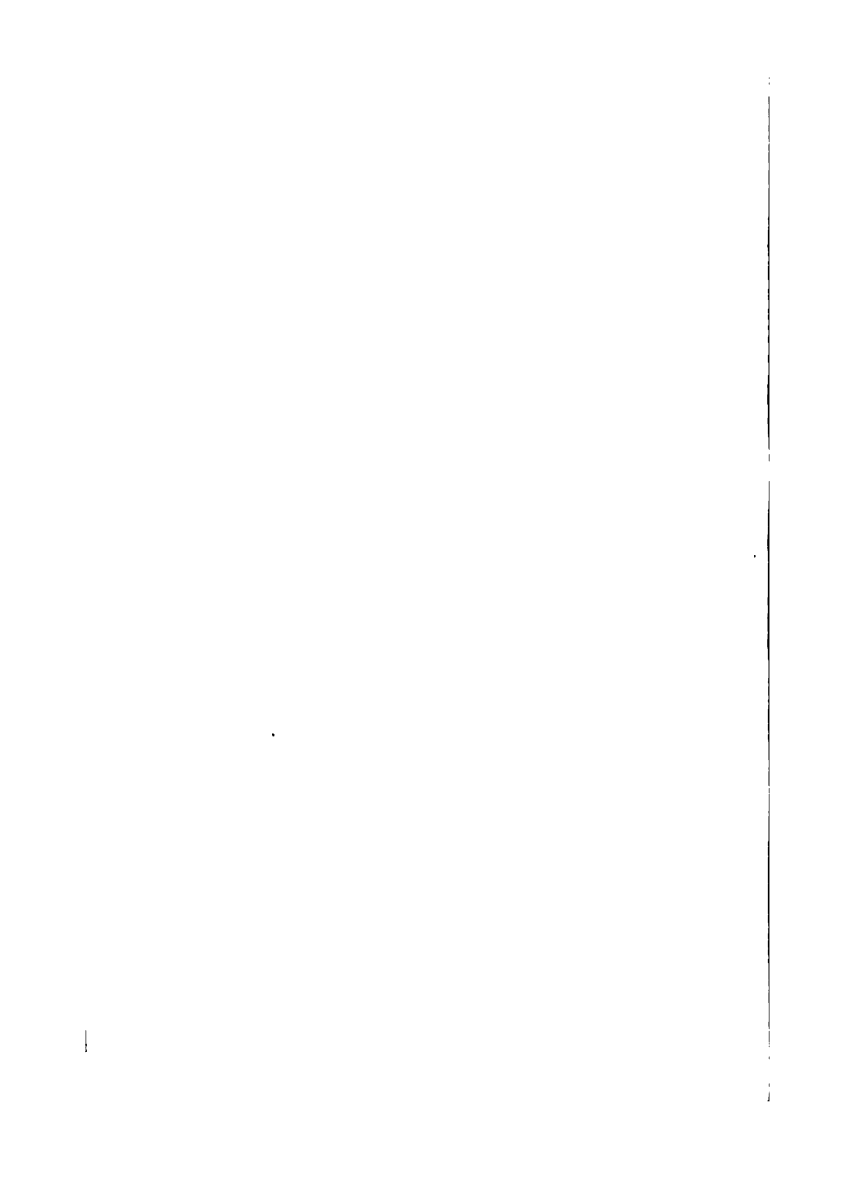
Report of these tests will be submitted to the officer in charge of the aviation section, with the information as to whether or not the school will complete the training of the aviator through the reserve military aviator stage.

If the preliminary flying test is passed satisfactorily, and a candidate qualifies in other respects, he will be eligible for further instruction to qualify as a reserve military aviator.

Therefore the pilot undertakes a more thorough understanding of aviation which is here set forth.



DAILY PRACTICE



DAILY PRACTICE

The student is now a recognized aviator—a pilot, and is starting on approximately the sixth month of his instruction.

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aviator*

A systematic method of putting into practice the course he has undergone, with the addition of “stunt” flying necessary to complete the knowledge of an expert aviator, makes up the final month’s program.

JOHN B.
MOISANT

On the First Day, then, the pilot should take his machine up to an altitude of between four hundred and a thousand meters, and practice volplaning and volpiqueing from these altitudes. During these long descensions, he should undertake and practice the

SPIRAL GLIDE or SPIRALING, a

HOW TO FLY

An method of descending in wide circles, corkscrew fashion.
aeroplane
is as

safe *On the Second Day* the pilot
as should mount to the same altitude
its and execute similar spiral glides,
pilot narrowing the circles to a smaller
ORVILLE and smaller degree.
WRIGHT

On the Third Day he may make the circles still smaller, and so on, until at the end of a week of this exacting practice *in Dead Calm Weather*, he is capable of skillfully executing a very sharp spiral dive.

It is essential to know the spiral dive since the aviator may be placed in the tight position of finding himself directly over a landing-spot in some city with his motor "gone dead." The only possible safe landing then is a spiral dive.

DAILY PRACTICE

The Second, Third and Fourth Weeks should be made up of short cross-country flights, steep-banking and steep-diving at safe altitudes, climbing, and calculated landings.

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successful
aviator*

To Practice Calculated Landings the pilot should climb to an altitude of at least a thousand meters, cut his engine off, and land as closely as possible to a pre-designated spot.

JOHN B.
MOISANT

When the pilot is capable of landing from an altitude of a thousand meters with his engine off to within a hundred meters of a pre-designated landing-spot, he should then undertake and practice

OBSTACLE LANDING, after the following manner:

Assuming that a ten-foot fence is placed at one end of a field five

HOW TO FLY

An hundred meters in length, the avi-
aeroplane ator, flying at an altitude of not
is as under a thousand meters, finds his
safe engine "gone dead." He starts a
as spiral glide in wide circles. His
its only available landing-spot, he dis-
pilot covers, is this field, the only en-
ORVILLE trance to which is by passing over
WRIGHT this ten-foot fence.

Called upon to descend, he passes over the fence as closely as he can skim it with safety, in order to land within the five hundred meters of the field.

It is well to practice this emergency landing on the aviation field as the pilot may be called upon to execute it at some future date.

In Climbing, the usual practice is made up of wide circles.

The pilot should leave the ground, climbing gradually. It is

DAILY PRACTICE

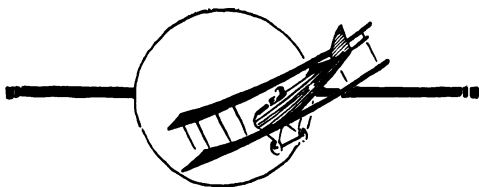
very easy to stall, and stalling is the most dangerous predicament a mounting aviator can get into.

At the completion of his month of daily practice in the air, the pilot is ready to fly for his EXPERT AVIATOR'S CERTIFICATE.

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**EXPERT AVIATOR'S CERTIFI-
CATE AND MILITARY BREVET**

EXPERT AVIATOR'S CERTIFI-
CATE AND MILITARY
BREVET

THE DEMANDS OF THE EXPERT
AVIATOR'S CERTIFICATE are as fol-
lows:

*A fifty-mile (appx. 32
kilometers) cross-country
flight, twenty-five miles
(appx. 16 kilometers) and
return. Ascension to an
altitude of at least 2,500
feet (appx. 770 meters),
and a volplane to within
100 meters of a predesi-
gnated point.*

The pilot is from now on recog-
nized by the AERO CLUB OF AMER-
ICA (Fédération Aéronautique In-

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HOW TO FLY

*An
aeroplane
is as
safe
as
its
pilot* ternationale) as an EXPERT AVIA-
TOR, and he is capable of passing,
if he so desires, the

RESERVE MILITARY AVIATOR TEST
as prescribed by the United States
Government, as follows:

ORVILLE
WRIGHT

1. Climb out of a field 2,000 feet square and attain 500 feet altitude, keeping all parts of machine inside of square during climb.

2. Glides at normal angle, with motor throttled. Spirals to right and left. Change of direction in gliding.

3. At 1,000 feet cut off motor and land within 200 feet of a previously designated point.

4. Land over an assumed obstacle 10 feet high and come to rest within 1,500 feet from same.

EXPERT AVIATOR'S CERTIFICATE

5. Cross-country triangular flight of 30 miles, passing over two previously designated points. Minimum altitude 2,500 feet.

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aviator*

6. Straightaway cross-country flight of 30 miles. Landing to be made at designated destination. Both outward and return flight at minimum altitude of 2,500 feet.

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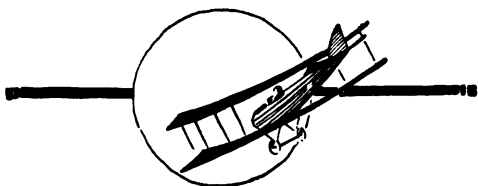
7. Fly for forty-five minutes at an altitude of 4,000 feet.

If, in addition to the preliminary flying test the candidate also passes the reserve military aviator's test satisfactorily, he will be given a commission in the aviation section, Signal Officers' Reserve Corps, provided all other (physical, educational) qualifications are fulfilled.

HOW TO FLY

An The expert aviator's continued
aeroplane practice in the air, then, should be
is as in accordance with the stipula-
safe tions and demands of the Reserve
as Military Aviator Test.
its
pilot

ORVILLE
WRIGHT



**SUGGESTIONS TO
INSTRUCTORS**



SUGGESTIONS TO INSTRUCTORS

Gather the students together when the weather is not propitious for flying and, in a body, carry on weekly discussions covering every phase of aviation.

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JOHN B.
MOISANT

Such problems as come up in the every-day flying should be freely gone into, and the students' opinions on what they would do when placed in awkward predicaments, solicited.

As an example of such problems, ask the students what they would do were they caught in a ninety-degree head-on dive from an altitude (at which time, of course, the elevators would not straighten-out the machine).

The correct answer would be:

HOW TO FLY

*An
aeroplane
is as
safe
as
its
pilot* To deviate the machine from its course by steering out of it with the rudder, either right or left, and then elevating.

ORVILLE
WRIGHT Ask the students what they would do if the machine were suddenly turned upside-down.

They should reply to this: Regain normal flying position by pulling the wheel toward the pilot and executing the bottom half of the letter S, coming out of the dive as set forth in the previous problem;

Or, by shoving the rudder right or left and warping with the turn, rolling wing over wing.

The students will suggest their own problems from their daily flying experiences, and will learn by the mistakes of others how to

SUGGESTIONS TO INSTRUCTORS

avoid and nullify danger in the sky.

The instructor should take up for discussion famous catastrophes of famous flyers, setting forth the solution that would have saved each in turn. These actual cases will serve as a splendid guide to students, will broaden and expand their knowledge of aerial science, will teach them to be self-reliant, to express their own opinions and deductions, to think rapidly and to the point.

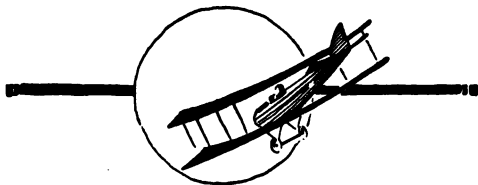
It is advisable to arrange a card-system for "checking-up" purposes, inscribed with the name of each student, the number of his flights, his progress, and requirements of practice. Some students need more attention, encouragement, and actual flying-practice than others, and this systematic

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MOISANT

An method of chronicling each candi-
aeroplane date enables the instructor to fol-
is as low along individual lines the tui-
safe tion in his school.
as
its

pilot *It is Further Respectfully Sug-*
ORVILLE *gested* that Aviation Schools
WRIGHT throughout the country lengthen
their course to include instruction
for the Expert Aviator's Certifi-
cate, which will enable the candi-
date to acquire, with the least pos-
sible delay, his Military Brevet.



METRIC SYSTEM

**METRIC SYSTEM
OF LENGTHS AND THEIR
RELATIVE VALUES**

MILLIMETER

is $1/1000$ of a meter or 0.0394 inch.

CENTIMETER

is $1/100$ of a meter or 0.3937 inch.

DECIMETER

is $1/10$ of a meter or 3.937 inches.

METER

is 1 meter or 39.37 inches.

DEKAMETER

is 10 meters or 393.7 inches.

HECTOMETER

is 100 meters or 328 feet, 1 inch.

KILOMETER

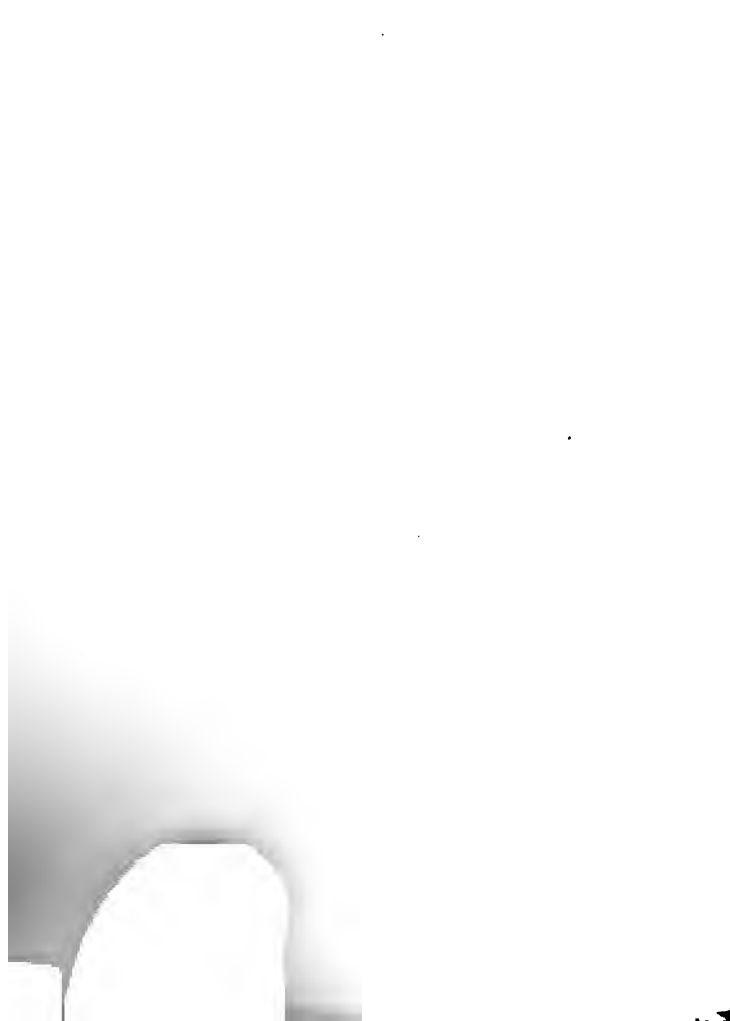
is 1,000 meters or 0.62137 mile (3,280 feet, 10 inches).

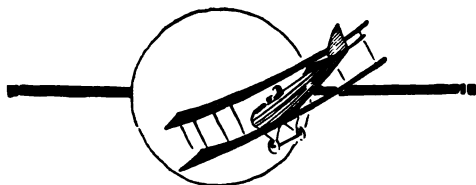
MYRIAMETER

is 10,000 meters or 6.2137 miles.

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MOISANT**





GLOSSARY



GLOSSARY

AS COMPILED BY
ALFRED W. LAWSON
(EDITOR OF "AIRCRAFT")

aeroboot (ā-ē'rō-bōat), a combination boat and aeroplane.

aerocar (ā-ē'rō-car), an enclosed passenger-carrying flying machine.

aerodnetics (ā-e-rō-do-net'iks), the science of gliding or soaring flight.

aerodrome (ā-ē'rō-drōm), (1) a flying race-course; (2) a structure for housing aerial vehicles; (3) a name proposed for flying machines and used by Prof. S. P. Langley for his tandem-planed machine (1896), now entirely superseded in this sense by the word aeroplane.

aerodynamics (ā-ē-rō-dī-nam'ics), the science of the air, of gaseous fluids and their forces.

aerofoil (ā-ē'rō-foil), a thin plane or curved structure suited to motion in

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HOW TO FLY

An the air; the sustaining member of
aeroplane the aeroplane; an experimental plane
is as surface of varying shape, used on
safe the whirling table for ascertaining
as the most efficient outlines and forms
its for use in aeroplanes and propellers.
pilot

ORVILLE **aeronaut** (ā-ē'rō-nawt), a navigator of
WRIGHT the air, particularly a balloonist
or pilot of a lighter-than-air flying
machine.

aeronautics (ā-ē-rō-nawt'iks), the en-
tire science of aerial navigation. See
aviation.

aeroplane (ā-ē'rō-plān), a self-pro-
pelled, heavier-than-air flying
vehicle having fixed sustaining
planes or surfaces, supported dy-
namically by its movement through
the air, also known by the names
aerodyne, aerodrome, flying ma-
chine, aeromobile, etc.

aerostatics (ā-ē-rō-stat'iks), the sci-
ence of buoyancy in the air by
means of displacement.

aerostation (ā-ē'rō-stā-shun), that part

GLOSSARY

of aerial navigation dealing with gas-borne or lighter-than-air machines.

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aileron (ā'le-ron), an auxiliary plane, flap or wing tip, placed near the extremity of the main wing of the aeroplane, on either side, and operated so as to prevent overturning sideways, and to assist in steering.

JOHN B.
MOISANT

aircraft (ār'kraft), (1) any human device that flies or floats in the air or pertaining to the construction thereof; (2) the aeronautical industry.

airship (ār'ship), a self-propelled lighter-than-air vessel for navigating the air; a dirigible, distinguished from an aeroplane or other heavier-than-air flying machine.

alighting-gear (ā-līt'ing-gēr), the portion of an aeroplane used in landing, including wheels, skids, underbody, shock-absorbers, etc.

anemometer (a-nē-mom'e-tēr), an instrument for measuring the forces of the wind, velocity, pressure, etc.

angle (ang'gl), (1) "of entry," the an-

HOW TO FLY

**An
aeroplane
is as
safe
as
its
pilot**

**ORVILLE
WRIGHT**

gle which the tangent to the leading convex edge of the surface of a plane makes with the chord; as, "an angle of entry of 45 degrees;" (2) "of incidence," the upward inclination of the planes of an aeroplane entering the air, when flying horizontally, usually from 5 to 12 degrees; also angle of the chord of the rib with the horizontal.

ascension (as-sen'shun), the act of ascending in a lighter-than-air device.

ascent (as-sent'), to ascend in a lighter-than-air vehicle. See *flight*.

aspect-ratio (as'pekt-rā'shi-ō), proportion of fore and aft dimension to transverse span; as, "1:6," the proportion of five feet of depth to thirty feet of width of the plan of the plane of an aeroplane.

aviation (ā-vi-ā'shun) or (av-i-ā'shun), the art, act, practice or science of mechanical flight in heavier-than-air machines; distinguished from aeronautics, which refers more to the science of ascension in lighter-than-air machines and balloons.

GLOSSARY

Aeronautics includes, in a certain sense, aviation, but is becoming more definitely differentiated and restricted to the latter meaning, aviation being the dominant word in reference to aeroplanes and aeroplaning.

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aviator (ā'vi-ā-tor), or (av'i-ā-tēr), a navigator of the air, in heavier-than-air machines, an aeroplane driver, also called airman, aeroman, bird-man, flyer, pilot.

JOHN B.
MOISANT

Avion (av'i-on), name of the first heavier-than-air flying machine, invented by Ader and flown in France 1897, with two steam engines.

balancing-plane (bal'ans-ing-plān), a surface, flap, web or other member for maintaining equilibrium.

balloonet (ba-lōōn-net'), a cell or subsidiary small balloon making up with others the interior of a larger balloon or dirigible, some of which usually contain air, so that in rising temperatures, the opening of the air balloonets gives room for the expansion of gas in the gas balloonets.

HOW TO FLY

An *banking* (bank'ing), making a turn
aeroplane with the inner side of the aeroplane
is as downward.
safe
as *barograph* (bär'ō-graf), a form of ba-
its rometer which automatically reg-
pilot isters the altitude reached by an
aeroplane and makes a record on a
ORVILLE continuous strip of paper of the va-
WRIGHT riations in altitude.

beam (bēm), the principal transverse member of the plane or wing to which the ribs are attached; *front beam*—*rear beam*.

biplane (bī'plān), an aeroplane having two main planes usually of equal size, one above the other. *Staggered biplane* (stag'ērd), one with planes offset, fore-and-aft manner. *Tandem biplane* (tan'dem), one with two main planes on the same level, one some distance behind the other.

camber (kam'bēr), the concavity or arch of an aeroplane wing as seen from the side of the machine when looking at the end of the wing; the fore and after curvature; the Philip's curve, imitative of the con-

GLOSSARY

- cavity of the underside of a bird's wing, the application of which to aeroplanes proved one of the greatest elements of progress ever introduced; in biplanes, usually of a depth of one-twentieth of the span.
- cavitation* (kā-vi-tā'shun), the formation of a partial vacuum in the zone of a rapidly revolving propeller due to its velocity.
- center* (sen'tēr), *center of flying gravity*; center of gravity of air-craft when in flight. *Center of pressure or resistance*, the point at which the resistance balances; or at which, if concentrated, it would have the same effect as when distributed.
- center of thrust or pull*, the point at which the driving force may be assumed to act. In an aeroplane flying in a normal state the centers of gravity, resistance and thrust form an equilibrated couple.
- chassis* (shas'si), the main framework of an aeroplane to which the essential members are attached; the understructure.
- Nine-tenths confidence plus one-tenth common-sense equals successful aviator*

JOHN B.
MOISANT

HOW TO FLY

An aeroplane is as safe as its pilot *control* (kon-trōl), *front control* (frunt), the elevator or auxiliary plane forward and its attachments for vertical direction of an aeroplane. *Lateral control* (lat'ēr-al), apparatus for regulating the list of the aeroplane.

ORVILLE
WRIGHT

control-lever (kon-trōl'lēv-er), a lever for steering an aeroplane either up or down or from side to side, or for maintaining lateral balance.

cross-country flight (krôs-kun'tri flīt), a flight over open or unprepared fields.

cruising radius (krüz'ing rā'di-us), the distance from a given point which marks the radius of a circle over which an aerial vehicle may conduct cruising operations.

curtain (kēr'tin), a fixed vertical surface located on the ends between the main-planes. See *vertical plane*.

deflector (de-flek'tēr), a plane or other surface for changing course of an aerial vehicle.

demountable (dē-mount'a-bl), capable

GLOSSARY

- of being readily taken apart to the extent necessary for transportation; as, a "demountable military aeroplane."
- dihedral* (dī-hē'dral); *dihedral angle*, the inclination of the wings of an aeroplane to each other, usually in the form of a flat V, the outer ends high, when viewed from the front, a form giving stability but dangerous in side winds if the machine banks. Mostly used on monoplanes.
- dirigible* (dir'ij-i-bl), steerable; also a self-propelled balloon, an airship, as Zeppelin's dirigible, usually cigar-shaped and of great size.
- distance-piece* (dis'tans-pēs), a piece holding other parts at required intervals; as, "distance-pieces between ribs."
- double-decker* (dub-l-dek'ēr), an aeroplane with two sustaining surfaces superposed; a biplane, as a "Farman double-decker."
- double-surfaced* (dub-l-sēr'fast), a

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MOISANT

HOW TO FLY

An plane covered on both the upper and
aeroplane under side of the ribs.

is as *edge* (ej), *entering edge* (en'tēr-ing),
safe the front edge of the planes of an
as aeroplane; *trailing* (trāl) *edge*, the
its rear or leaving edge of the plane.
pilot

ORVILLE *elevator* (el'e-vā-tēr), a horizontal
WRIGHT plane, either fore or aft of any fly-
ing device, used to steer it in an up-
ward or downward direction.

equalizer (ē'kwā-iz-ēr), an auxiliary
plane or device for lateral stability.

fin (fin), a small plane, flipper or blade
for purposes of ensuring greater
equilibrium; mostly on dirigibles.

flight (flīt), rise and passage of an
aeroplane through the air, distin-
guished from ascent, the rising of
a balloon.

flying-machine (flī'ing-ma-shēn'), an
apparatus or vehicle for navigating
the air, including all kinds of
heavier-than-air machines; any fly-
ing vehicle or device.

fuselage (fū-si-lāj'), (1) the frame-
work of an aeroplane or dirigible;

GLOSSARY

(2) that portion of a monoplane extending from the main body to the tail.

glider (glī'dēr), an apparatus without power for aerial gliding, constructed of planes, designed to carry an operator, his balance being maintained by shifting his position; as Lilianthal's glider. *Biplane-glider*, the type perfected by Chanute, which, when improved and fitted with an engine by the Wrights, became the biplane.

gliding-angle (glīd'ing-ang'gl), the angle at which an aeroplane travels when the power is cut off.

gyroscope (jī'ro-skōp), a device in which the axis of a heavy rotating body is also free to rotate in any direction and may be acted on by couples of forces. Numerous efforts have been made to utilize the resistance of a gyroscope to deflection from its plane as a means of maintaining lateral balance in aeroplanes.

hangar or *hanger* (hang'gär), (hang'gēr), a structure for housing aerial

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JOHN B.
MOISANT

HOW TO FLY

An vehicles; aeroplane shed. (The term
aeroplane is derived, through the French, from
is as an old Persian word for a post-
safe station.)
as

its **headless** (hed'les), without a head; a
pilot biplane having no front elevator,
ORVILLE such as the Wright headless.
WRIGHT

head resistance (hed re-zist'ens), that
portion of the resistance encoun-
tered by an aerial vehicle in flight
which cannot be utilized to assist in
its support; dead resistance.

helicopter (hel'i-kop-tēr), or (hē'li-
kop-tēr), an aerial vehicle sustained
and propelled by the action of the
screws, propeller or rotating planes
and without supporting planes; a
form advocated by many scientists
but not yet perfected mechanically.

hydroaeroplane (hī-drō-ā-ē'rō-plān),
an aeroplane capable of alighting on
and rising from the water (such as
Curtis' hydroaeroplane), distin-
guished from an aerohydroplane, a
hydroplane with wings, not capable
of rising entirely free of the water.

GLOSSARY

- ignition** (ig-nish'un), the means of exploding the mixture in an internal combustion motor, usually an electric spark from a magneto.
- knock-down** (nok'down), a flying machine as dismantled for shipment, or its collected parts prior to erection.
- lacing** (lās'ing), cord or string used in fastening the cloth covering of planes together, and to the ribs and beams.
- landing-chassis** (land-ing - shas'si), the landing framework or under body of an aerial vehicle.
- launching** (launch'ing); **launching derick** (der'ik), a catapult for starting a flying machine; **launching rail** (rāl), a track or bar for launching into the air.
- lifting propeller** (lift'ing pro-pel'ēr), a propeller for raising flying machines without forward movement.
- list** (list), careen or incline sideways of an aerial vehicle; banking.
- lubrication** (lū-bri-ka'shun), splash lu-

Nine-tenths confidence plus one-tenth common-sense equals successful aviator

JOHN B. MOISANT

HOW TO FLY

**An
aeroplane
is as
safe** *brication*, oiling of internal parts of motor by working parts splashing in a sump of oil.

**as
its
pilot** *mast* (mast), upright part, usually extending upward from the center of a monoplane for support of guy and truss wires and controls. A vertical upright in either the main or supplementary planes.

**ORVILLE
WRIGHT**

monoplane (mon'ō-plān), an aeroplane with a single main sustaining surface, or with a single wing on either side of the body. *Tandem monoplane* (tan'dem), a monoplane with two main planes, one in front of the other, not superposed. A *biplane* (bī'plān), has two planes, a *triplane* (trī'plān), three planes, and a *multiplane* (mul'ti-plān), a greater number.

ornithopter (ôr-ni-thop'tēr), a heavier-than-air aerial vehicle with flapping wings, imitative of bird flight.

outrigger (out'rig-ēr), framework extending to the front or the rear to support the elevator or tail.

GLOSSARY

- Phillips' curve** (fil'ips kērv), the curve similar to the underside of a bird's wing applied by Phillips to the aeroplane. See *camber*.
- phugoid** (fū'goid), **phugoid curve**, a curve showing the flight-path of an aerofoil.
- pitch** (pitch), the distance through which a given point of a propeller advances during one revolution, parallel to the axis, in a solid nut.
- plane** (plān), a supporting surface of an aeroplane.
- pocket** (pok'et), a loop formed either in the end of the cloth surface or by sewing on an additional strip; provided for the ribs and beams of a single-surfaced plane to lessen skin friction.
- power-plant** (pow'ēr-plant), the entire apparatus for generating power on an aeroplane, including motor, propeller, radiator, gasoline tank, etc.
- propeller** (prō-pel'ēr), a device with two or more blades set at a pitch

*Nine-tenths
confidence
plus
one-tenth
common-
sense
equals
successful
aviator*

JOHN B.
MOISANT

HOW TO FLY

An which translates rotary force into
aeroplane straight line motion; a screw;
is as *tractor propeller* (trak'tor), a pro-
safe peller on the front of an aeroplane,
as drawing the machine forward, as on
its the Bleriot monoplane.
pilot

ORVILLE *pterygoid* (ter'i-goid), having the shape
WRIGHT of a wing, as "pterygoid aspect."

pylon (pē-long), a mark in the course
of an aerodrome.

rib (rib), a longitudinal horizontal
member of an aeroplane wing, to
which the covering is attached, and
whose shape determines the curve
of the wing. *Laminated rib*, a rib
built up of laminations of wood,
glued together to enable it to hold
its shape.

rudder (rud'ēr), an auxiliary plane or
surface either at front or rear of
an aerial vehicle for steering; also
called *vertical rudder* (vēr'ti-kl).
The *horizontal rudder* (hor-i-zon'-
tal) is for steering up or down, and
the stabilizing rudder or aileron for
maintaining equilibrium.

GLOSSARY

- running-gear* (run'ing-gēr), that part of a flying machine which enables it to travel on the earth.
- shock-absorber* (shok'ab-sôrb-ēr), an apparatus for deadening the impact of an aeroplane upon alighting.
- single-surfaced* (sing'-gl-sēr'fast), a plane covered on only one side.
- skid* (skid), a sled-like runner, part of the running gear of an aeroplane.
- skin-friction* (skin'frik-shun), the friction between the surface of the planes and other parts of the flying machine, and the passing air; distinguished from the head resistance due to displacement of the air; much less for smooth surfaces than for rough ones; skin resistance.
- slip* (slip), the loss of efficiency of a propeller, the difference between its theoretical advance and the real advance in practice. See *pitch*.
- soaring* (sôr'ing), flight without power, effected by taking advantage of rising, or unequal currents of air.

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HOW TO FLY

An *spread* (spred), distance from tip to
aeroplane tip of wings of an aeroplane, as "the
is as spread of a Curtis is 28 feet."
safe

as *stability* (sta-bil'i-ti), steadiness in
its flight; *automatic stability* (aw-tō-
pilot ma't'ik), maintenance of equilibrium
in automatic manner. *Longitudinal*
ORVILLE *stability* (lon-gi-tū'di-nal), steadiness
WRIGHT in a fore-and-aft direction; *horizon-*
tal or *lateral stability* (lat'ēr-al),
steadiness from side to side.

stabilizer (stā'bl-iz-ēr), a plane or
other device for securing steadiness.

staggered (stag'ērd), arranged in steps
or offset; zig-zag, said of planes of
aeroplane.

stanchion (stan'shun), an upright be-
tween the planes of a biplane, a
post, a strut.

steering (stēr'ing), guidance of an
air-craft in flight. *Vertical steering*,
up and down as distinguished from
lateral or *right* and *left steering*.

stream-line-form (strēm'līn-fōrm), that
form of a body which enables it to

GLOSSARY

- pass through liquid or gas with the best possible resistance; ichthyoid, or fish-like form. *Nine-tenths confidence plus one-tenth common-sense equals successful aviator*
- strut* (strut), a brace or support under compression stress; an upright between planes. **JOHN B. MOISANT**
- tail* (tāl), rear portion of an aerial vehicle used for steering and balancing.
- tetrahedral cell* (tet-ra-hē'dral sel), a tetrahedron whose sides are four equilateral triangles, open front and rear, the sides being surfaces. A large number of such cells when built up acting as a sustaining surface, as in the tetrahedral aeroplane of Prof. Alexander Graham Bell.
- thrust* (thrust), the push or traction exerted by the propeller; as, "the propeller developed 350 pounds thrust," i. e., showed on a scale 350 pounds pull to hold the aeroplane motionless.
- torque* (tôrk), moment of twisting force; the force tending to overturn an aeroplane sideways, due to the

HOW TO FLY

An reaction of the propeller in turning
aeroplane in the opposite direction, overcome
is as by having two propellers operating
safe in opposite directions or making the
as wing on one side slightly larger than
its the other.
pilot

ORVILLE *turnbuckle* (tĕrn'buk-l), a connection
WRIGHT for tightening wires, rods, etc., consisting of right and left hand threaded eyelets or swivels in a sleeve, the turning of which varies its length.

velocity (ve-los'i-ti); *natural velocity* (nat'ū-ral), the speed at which an aeroplane will continue to glide indefinitely without power.

volplane (vōl'plān), to glide or coast without power in an aeroplane.

wake (wāk), track or stream of disturbed air following the course of an aeroplane.

war plane (wawr' plane), an aeroplane designed for use in warfare.

wash (wash), the disturbed air immediately behind an aerial vehicle; dead air.

GLOSSARY

- web* (web), wooden or other material used as distance pieces between the ribs of a sustaining plane. *Nine-tenths confidence plus one-tenth common-sense equals successful aviator*
- whirling-table* (hwhêrl'ing-tâ-bl), an apparatus comprising a vertical axis and a horizontal arm for revolving planes or aerofoils and determining their effects and efficiency. The use of the whirling-table led to the experimental determination of numerous aerial laws and directly to the perfection of the aeroplane. **JOHN B. MOISANT**
- wind-pressure* (wind'presh-ūr); *co-efficient of wind pressure* (kō-ef-fish'ent), the numerical constant of the pressure of the wind against a stationary object, or of the resistance of the air to a moving object.
- wing* (wing), one of the pair of sustaining planes of a monoplane; a sustaining surface.
- wing-spread* (wing'spred), area of surface of wings; distance from tip to tip.
- wing-surface* (wing'sēr-fas), wing area, surface measurement of wing.

HOW TO FLY

An wing-tip (wing'tip), the outer extremity of the wings of a monoplane; an aileron or other movable surface at end of wing.

is as safe as its pilot wing-warping (wing'wawrp-ing), deflection of a portion of an aeroplane wing; as the Wrights' warping wings; the bending of the rear outer corners of the wing on one end in an opposite direction from those of the other end, attaining lateral equilibrium.

ORVILLE
WRIGHT



THIS IS THE BOOK "HOW TO FLY," WRITTEN BY CAPTAIN D. GORDON E. RE VLEY FOR THE MANY WHO DESIRE THIS KNOWLEDGE, ARRANGED BY GLAD LEWIS, AND PUBLISHED BY PAUL ELDER AND COMPANY UNDER THE SUPERVISION OF RICARDO J. OROZCO, THEIR PRINTER, DURING THE MONTH OF JULY, NINETEEN SEVENTEEN



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